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Hypothetical Origins of Paleozoic Fossils from the Gulf Coastal Plain of Arkansas

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Abstract

A fauna of reworked Paleozoic fossils has been found in chert pebbles from the Gulf Coastal Plain in eastern Columbia County, Arkansas, although the nearest mapped exposure of Mississippian and Pennsylvanian rocks are fifty-five miles northward in the southern edge of the Ouachita Mountains. The surficial rocks at the collection site have been referred to the Claiborne Group of Eocene age by the authors of the geological map of Arkansas. Additional outcrops containing similar Paleozoic fossils have been found within a 15-mile radius. The fauna includes both lacy and twig-like bryozoans, articulate brachiopods, tabulate and rugose corals, stalked echinoderms, gastropods, fusulinids and two trilobite pygidia (17 mm wide by 15 mm long and 16 mm wide by 5 mm long) of two distinct taxa. The fossils resemble those of a carbonate platform such as northern Arkansas but would have to be delivered southward before the Arkansas River drainage developed. The possibility of an origin from the south is being considered.

Introduction

The surficial rocks of Columbia County, Arkansas, have been referred to the Claiborne Group of Eocene Age by the geological map of Arkansas; but recently, a fauna of silicified, reworked, Paleozoic fossils has been discovered in the eastern part of the county. Searching the exposed gravels of the area has resulted in the recovery of Paleozoic species fossilized among cherts, quartz, and some exotic lithologies that have yet to be identified. The general lithology of the fossiliferous rocks is of shallow water limestone silicified into chert. The purposes of this investigation are to establish the paleoenvironmental implications of the fossils and their age and to explain their hypothetical origins.

Materials and Methods

Specimens were collected from the site (an exposed gravel bed, see Fig. 1 for a map of the sites) and then examined with stereo-microscopes. Pictures were taken of the more photogenic specimens and were sent to various paleobiology experts selected from those with recent publications of relevant taxa in the *Journal of Paleontology*. The experts' specialties include trilobites, bryozoans, brachiopods and blastoids.

Latex peels of the trilobite pygidia and a few bryozoans were also enclosed with the photographs. Eight sets of photographs/peels were dispatched in the initial mailing and half of the experts responded. Two other individuals were contacted later for additional information and to have the fusulinids identified. The *Treatise on Invertebrate Paleontology* (Moore, 1953) was consulted for confirming identifications and for paleoenvironmental information.

Results and Discussion

Bryozoans are the most numerous group among the fossils recovered to date. Some of the bryozoan specimens are now referred to the Family Rahbdomesidae by their characteristic elongate, tubular zooids that are typically curved or bent to the surface and their generally solid stems that may be branched or unbranched. Species from this family appear in the Silurian and disappear in the Permian. Other specimens were identified as belonging to the Family Fenestellidae by the way the zoaria form fan-shaped fronds in which the fenestrules (open spaces) are of circular, elliptical, or quadrangular form that extends through the zoarium. Fenestellid bryozoans appear in the geologic record from the Ordovician to the Permian (Moore, 1953). Petrographic thin sections may be helpful in further identification of these specimens since important taxonomic information is at the scale of the individual zooid.

However, colony formation can be a paleoenvironmental indicator. The Rahbdomesid forms recovered grow away from the sea floor as brittle bushes made of round stems. Fenestillid forms grow as bushes of flattened branches. When these delicate forms are preserved in their entirety, as observed in specimens from the collection, it is believed that they grew in a quiet environment (McKinney and McKinney, 1996). The abundance of fenestrate fronds indicates that they were probably the most important aspect of the multitiered, epifaunal, suspension-feeding community. One specimen of *Archimedes*, a fenestellid with lacy fronds attached to a spiral axis, has recently been discovered (6/10/00), which leads us to believe that part of the fauna may represent the Mississippian Period. That genus is abundant in rocks of this period in northern Arkansas.

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Fig. 1. A map of the eastern Columbia County site area. The two main collection sites are indicated by the arrows.

Among the more interesting finds are two trilobite pygidia of different taxa. The first pygidium found (specimen no. 7) isn't well preserved but does resemble forms that would occur in the Carboniferous (D. K. Brezinski, pers. comm.). However, James D. Loch has suggested that it may be consistent with the Family Bathyuridae (Lower to Upper Ordovician). The characteristics that specimen no. 7 exhibits include a strong axis, convex pleural fields (the slopes beside the axis) and a poorly defined border (J. D. Loch, pers. comm.). The second pygidium (specimen no. 41) has two possible identifications. It may belong to the Family Trinucleidae and may even be of the genus *Cryptolithus* or *Trinucleus* (Brezinski, pers. comm.; Loch, pers. comm.). If truly a member of either of those genera, then the specimen is most likely Middle to Upper Ordovician in age since all close relatives of *Cryptolithus* occurred during this

time. Alternatively, specimen no. 41 may belong to the Family Raphiophoridae (including the genera *Ampyx, Ampyxina, Cnemidopyge,* and *Lonchodomas*) which is also Middle to Upper Ordovician in age. Both families exhibit a short, broad tail which looks triangular in outline with a low axis (central ridge) which reaches the posterior edge (Loch, pers. comm.). This identification raises the possibility of a mixed fauna as many of the other taxa seem to represent an Upper Carboniferous age.

Specimens from several groups of brachiopoda have also been identified. The specimens resemble those seen in the mid-continent Carboniferous (Paul Cooper, pers. comm.). No typical Ordovician brachiopods were identified from the photographs sent to paleobiologists. Taxonomy and identifiable characteristics include the following:

1) Order Terebratulida - Specimen 15 and 16 agree with the following terebratulid characteristics as given by the *Treatise on Invertebrate Paleontology* (Moore, 1964): 1) a punctate nature 2) the common teardrop shape 3) usually smooth surface which may be finely to coarsely plicate with folds and sulci. (Late Devonian - Recent)

2) Order Rhynchonellida - Specimen numbers 3, 20, 36, 38, and 39 agree with the following rhynchonellid characteristics as given by the *Treatise on Invertebrate Paleontology* (Moore, 1964): 1) rostrate shell 2) developed functional pedicle 3) normally impunctate shell. (Middle Ordovician - Recent)

3) Order Orthida - Specimen no. 5 agrees with the following orthid characteristics as given by the *Treatise on Invertebrate Paleontology* (Moore, 1964): 1) biconvex strophic shell 2) shell substance normally impunctate 3) well developed hinge line. (Late Cambrian - Upper Permian)

4) Order Productidina - Specimen no. 17 agrees with the following productid characteristics as given by the *Treatise on Invertebrate Paleontology* (Moore, 1964): 1) pseudopunctate shell 2) flat or concave brachial valve. (Late Devonian - Upper Permian)

5) Order Spiriferida - Specimen no. 14 agrees with the following spirifid characteristics as given by the *Treatise on Invertebrate Paleontology* (Moore, 1964): 1) long hinge line 2) mostly biconvex valves with relatively large body cavity. (Middle Ordovician - Jurassic)

The collection also contains specimens of rugose and tabulate corals, stalked echinoderms (including both crinoids and blastoids), gastropods, and planispiral fusulinids. These specimens remain to be identified to lower taxonomic levels but are consistent with a Pennsylvanian age for the fauna. Identification of the fusulinids may be the crucial factor for determining the source area of the fauna since their wide geographic range, large numbers, and narrow stratigraphic interval make them an excellent index fossil (Moore, 1964).

It has been called to our attention that deposits containing fusulinids are found among terrace deposits along the Arkansas River but these large forams are not seen in north Arkansas rocks (McFarland, pers. comm.). These fusunlinids are thought to be of early Permian Period and may have originated in Oklahoma. Further identification of the fusulinid species and their age from the eastern Columbia County sites will be pursued to confirm this hypothesis.

There are three hypothesized source areas for the gravels: northern Arkansas, Oklahoma or other areas west of the Ozark Dome, or Gondwana.

I. Northern Arkansas as Source.--The fossils resemble those of a carbonate platform (multitiered, epifaunal, suspensionfeeding, reef community with deposit feeders) such as in northern Arkansas during the Mississippian and Early Pennsylvanian Periods. If the assemblage did originate in northern Arkansas, then it would have had to be transported southward before the Arkansas River drainage developed or the specimens would have been transported eastward, away from Columbia County (Fig. 2). A three-step process is hypothesized to explain such an event:

1) The shallow-water reef fauna of northern Arkansas was fossilized, erosion took place, and the fauna was transported south to the Ouachita Trough before the Middle Pennsylvanian, when the trough would have been closed as a result of the collision of Laurasia and Llanoria (Guccione, 1999). It is possible that a reworked Ordovician fauna was

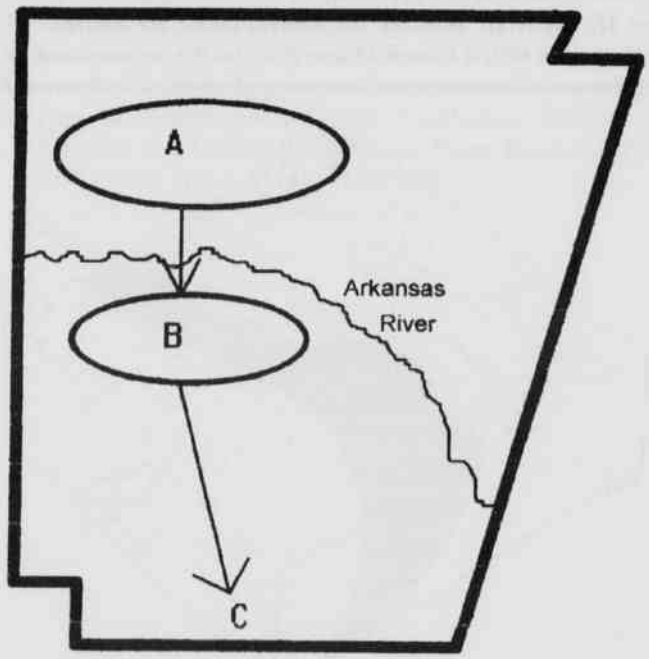

Fig. 2. Northern Arkansas as a source (diagram by Karen Abruckle and Leo Carson Davis).

eroded and deposited along with the Pennsylvanian. In theory, both could have been exposed, eroded and transported simultaneously which would account for the Ordovician trilobites that were recovered among Pennsylvanian specimens.

2) During the Middle to Late Pennsylvanian Period, the uplift of the Ouachitas exposed the fauna, along with deep ocean basin sandstone and chert that had been accumulating during the Paleozoic

3) The fossils could have been transported south to the Columbia County area by rivers during the Triassic Period. During the Triassic sand and gravel from the high Ouachita Mountains was eroded, transported south and filled the troughs formed as South America split apart from North America, and blocks were down faulted as a result (see Fig. 3). Another possibility is that the fauna was transported by turbidity currents during wide-spread inundation of the Jurassic to Early Tertiary (Fig. 4). With the Ouachita Mountains above sea level, sand and gravel was eroded and deposited in streams, beaches, and deltas. This would have positioned the material so that a turbidity current could transport it southward to the Columbia County area where it would have been buried by younger material until the recent erosion of the area exposed it once again.

II. An Area West of the Ozark Dome as Source.–The region west of the Ozark Dome may be the source area and eastward flowing rivers transported the fauna to southern Arkansas. A river flowing to the south on the west side of the Ozark Dome (hypothetically referred to as the proto-Sabine River) may have been progressively beheaded (Fig. 5), first by the Red River and later by the Arkansas River and then the Missouri River. The Red River would then be the agent that transported sediments eastward and deposited the assemblage in the Columbia County area.

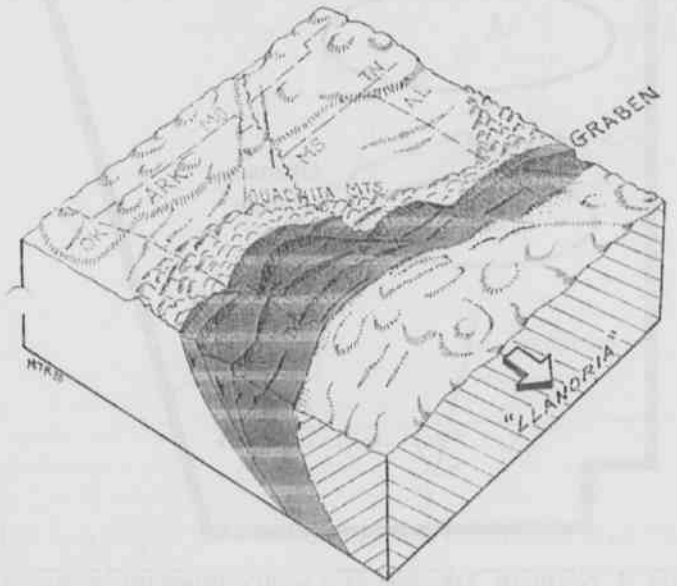

Fig. 3. Triassic rifting of Pangaea in Arkansas (block diagram from *Geologic History of Arkansas Through Time and Space,* Guccione, 1993).

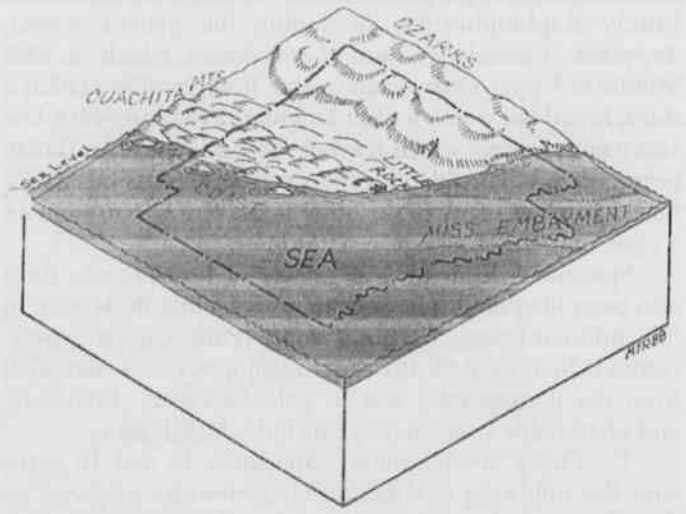

Fig. 4. Paleogeography of Arkansas during the Cretaceous Period (block diagram from *Geologic History of Arkansas Through Time and Space*, Guccione, 1993).

III. Gondwana as Source.--A southern origin from a Gondwana-Llanoria landmass is also being considered (Fig. 6). The collision of the Llanorian and Laurasian plates provided significant quantities of sediment from the southeast

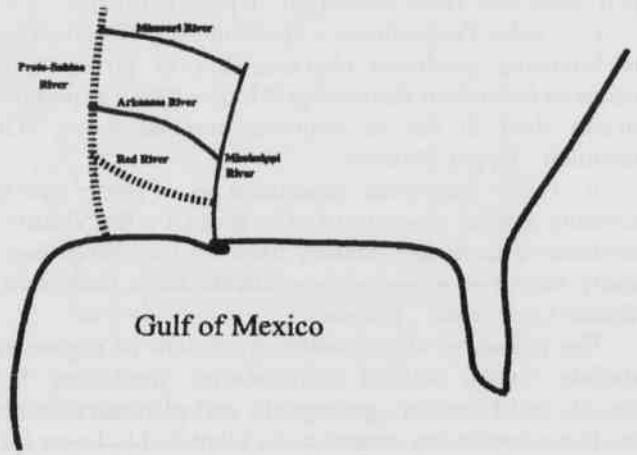

Fig. 5. A diagram depicting a hypothetical western drainage system (diagram by Karen Arubuckle and Leo Carson Davis).

and south to the Ouachita Trough during the Late Mississippian to the Middle Pennsylvanian time (Gordon and Stone, 1977). Fossils with a Gondwana origin could have been transported into the trough at the same time. Uplift and erosion of the Ouachita Mountains could have exposed the material and allowed it to be transported south to Columbia County by the processes previously described in stage 3 for a "northern origin".

An eastern origin has also been considered but is regarded as being less likely. In order for the fauna to be deposited in the Ouachita Trough, it must have been fossilized and transported before the Ouachita Trough closed in the Middle Pennsylvanian. Since some of the fossils are referred to the Pennsylvanian Period, it seems unlikely that this process could have taken place in such a short time.

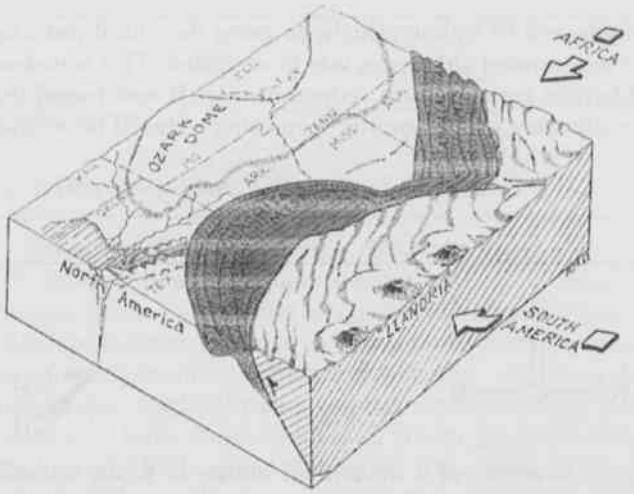

Fig. 6. Middle Pennsylvanian paleogeography of Arkansas (block diagram from *Geologic History of Arkansas Through Time and Space*, Guccione, 1993).

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